INTERACTIVE, MENU-DRIVEN INTERFACE TO DATABASE

Technical Field

This invention generally relates to cellular communications. More particularly, the present invention relates to an interactive, menu-driven interface to cell site information in a database.

Background of the Invention

With the increasing popularity of cellular phone communications, managing the data associated with calls to and from cellular phones has become increasingly complex. For example, one type of data that is managed is cell face transfer data. Cellular phone systems typically include a cell face (or antenna) mounted on an antenna tower receiving calls from cell phones. A cell face receives calls within an associated geographic coverage area called a cell. An antenna tower can have multiple cell faces oriented at different angles to handle calls originating from multiple directions around the antenna tower. A process is employed in order to choose a cell face that handles the call from each cell phone. The process of selecting and switching among cell faces involves the

use of data that designates available cell faces. A neighbor list in the database specifies the neighboring cell faces to which the current call may be handed off to. Before handing a call to a neighboring cell face, signal strengths from all the neighboring cell faces are measured and the cell face with the strongest signal strength is designated for hand-off. For example, as a mobile call moves away from one cell face, the neighbor list is accessed to select another cell face that is closer to the call so that the call can be handed off to the closer cell face.

The neighbor list data and numerous other types of data (such as cell data, channel data, trunk group and member data, device data, etc.) may be stored in a database of a cellular network, such as one manufactured by Ericsson. Sometimes, this data is stored in different forms in the database. Making changes to data in one of these forms may be complex. For example, typically an operating system in the cellular network is used to access a command handler application. The command handler application accepts line commands and performs updates and revisions to the database based on these line commands.

One problem with these line commands is that they are not intuitive to a user because a user must be familiar with specific line commands in order to enter the correct line commands and make the proper updates and revisions. Another problem is that there is no interactive interface to make the changes to the data. Instead, the user must enter line commands.

Summary of the Invention

Cellular site information is often stored in databases, such as a database manufactured by Ericsson. Updating this cellular site information is often difficult because specific line commands, or scripts, must be entered into a command handler application. Thus, one problem with updating cellular site information is that a specific knowledge of these line commands is necessary to make changes to the cellular site information databases. Another problem is that even if a user has knowledge of the required line commands, the user, when making multiple changes to the database, may

make mistakes entering these line commands. Thus, the present invention, in one embodiment, provides an interactive menu-driven interface to the database to eliminate the need for knowledge of specific line commands and to reduce the number of errors made.

In one embodiment, the invention is an interactive, menu-driven interface to a cellular site information database. The user may enter a form name such as channel, cell, trkgrp, trkmem, etc. into a form selection screen. The user may enter the operation desired to be performed on the form such as review, delete, insert, update, etc. to choose which form to view. After the user has entered the form name and the operation desired into the interface, the entered form is displayed to the user. A query, such as a SQL query, is issued to populate the fields of the form displayed on the interface with data from the database. The user may select one or more of the fields in the form and make revisions, addition, edits, etc. The user may then select the action command such as insert, review, update or delete. Commands, such as SQL commands, are generated to perform the action desired by the user on the database.

In one embodiment, the invention is a computer-implemented method for providing an interactive, menu-driven interface to a cellular site information database comprising cell site data. A form name input is received from the user identifying the form data in the cellular site information database that the user wants to view or edit such as cell data, channel data, trunk group and member data, device data, etc. A blank form may then be displayed to the user including a key field. The user may then input a value into the key field identifying a particular cellular site that the user wants to view or edit. For example, the user may enter channel for the form name input and then enter G003A for the key field indicating that the user wants to view the channel data for cell site G003A.

Queries, such as SQL queries, may be generated to retrieve the data corresponding to the identified cell site from a cellular site information database. The queries are sent to the cellular site information database and the appropriate data, such as channel data,

corresponding to the identified cell site from the cellular site information database is retrieved. The data is displayed to the user in an interactive, menu-driven interface. The user may make changes as necessary. When the user is finished making changes, commands, such as SQL commands, are generated and sent to the cellular site information database to make the appropriate changes to the data.

These and other features, advantages, and aspects of the present invention may be more clearly understood and appreciated from a review of the following detailed description of the disclosed embodiments and by reference to the appended drawings and claims.

Brief Description of the Drawings

Figure 1 is an exemplary cellular operating environment implementing an embodiment of the present invention.

Figure 2 is a multiple cell operating environment implementing an embodiment of the present invention.

Figure 3 is a diagram illustrating a cellular processor including a forms database.

Figure 4 is an illustration of a form selection screen in accordance with an embodiment of the present invention.

Figure 5 is an illustration of a form selection screen in accordance with an embodiment of the present invention.

Figure 6 is an illustration of the interactive, menu-driven interface displaying a channel form in accordance with an embodiment of the present invention.

Figure 7 is a flow diagram illustrating a method for updating a database form in accordance with an embodiment of the present invention.

Detailed Description

In one embodiment, the present invention is an interactive, menu-driven interface for a cellular network database, such as a database manufactured by Ericsson. Currently, there is no interactive interface to modify forms in the Ericsson database. Instead, a user has to use a command handler application and enter one or more line commands (such as

mtcgc:dev=mvdc-1001, vcg=vcge3 to change the value of the vcg field for device "mdvc 1001" to vcge3). In one embodiment, the present invention displays an interactive interface that supplies the user with a form requested by the user. The form may include a plurality of fields. The user may navigate an insertion point to different fields of the form, make changes to the fields as needed and then update the form without using line commands. Structured Query Language (SQL) commands may be generated to update the database.

In one embodiment, the invention is a computer-implemented method for providing an interactive, menu-driven interface to a cellular site information database comprising cell site data. A form name input is received from the user identifying the form data in the cellular site information database that the user wants to view or edit such as cell data, channel data, trunk group and member data, device data, etc. A blank form may then be displayed to the user including a key field. The user may then input a value into the key field identifying a particular cellular site that the user wants to view or edit. For example, the user may enter channel for the form name input and then enter G003A for the key field indicating that the user wants to view the channel data for cell site G003A.

Queries, such as SQL queries, may be generated to retrieve the data corresponding to the identified cell site from a cellular site information database. The queries are sent to the cellular site information database and the appropriate data, such as channel data, corresponding to the identified cell site from the cellular site information database is retrieved. The data is displayed to the user in an interactive, menu-driven interface. The user may make changes as necessary. When the user is finished making changes, commands, such as SQL commands, are generated and sent to the cellular site information database to make the appropriate changes to the data.

Having briefly described an embodiment of the present invention, an exemplary operating environment for the present invention is described below in reference to Figure 1. Referring now to the drawings, in which like numerals represent like elements

throughout the several figures, aspects of the present invention will be described.

Figure 1 illustrates a suitable operating environment **200** utilizing an embodiment of the present invention. The environment **200** is generally a cellular telephone system for receiving and transmitting cellular phone calls. A cellular phone **202** is transmitting a signal **204** within a cell **206**. The cell **206** is a geographic area generally defined by a boundary **208**. The cell includes an antenna tower **210** that has transmitters and receivers for transmitting and receiving signals. The transmitters on the antenna tower **210** transmit at a designated power level. Likewise, the cell phone **202** transmits the signal **204** at a designated power level. The designated power levels of the antenna tower transmitters and the cell phone **202** dictate the location of the boundary **208** of the cell **206**. Receivers on the antenna tower **210** will generally receive the signal **204** while the cell phone **202** is within the boundary **208** of the cell **206**. Generally, when the cell phone **202** leaves the boundary **208** of the cell **206**, the receiver of the antenna **210** will no longer receive the signal **204**. In one embodiment, the cell boundary **208** is substantially hexagonal in shape.

A receiver on the antenna tower **210** is generally referred to as a cell face. The antenna tower **210** may have more than one cell face, such as a cell face **212** and cell face **214**. A typical antenna tower has three cell faces, but the number of cell faces can vary. Each cell face on the antenna tower **210** is positioned so that it covers an area within the cell **206**. Depending on the positioning and the orientation of the cell face **214**, the cell face **214** will receive calls coming from a particular direction. The cell face **212** is oriented in a different position to receive calls coming from a different direction with respect to the antenna tower **210**. A variety of cell face configurations are known in the art. For example, one cell face configuration is known as the omni face, which comprises a single cell face with a coverage area of 360 degrees around the antenna tower. A common cell face configuration includes three cell faces with each cell face having a coverage area of 120 degrees around the antenna tower. Typically a structure **216** is located near the antenna tower that houses communications equipment, such as radio

transmitters, radio receivers, and power supplies. The communications equipment is connected to transmitters and cell faces on the antenna tower via a communications link **218**. The structure **216** and the antenna tower **210** are commonly referred to as a base station **220**. The base station **220** is located substantially in the middle of the cell **206**.

Each cell face on the antenna tower **210** has an associated transmitter. Transmitters transmit control signals on unique control channels or frequencies that are used to send control messages to the cell phone **202**. When the cell phone **202** is in operation, the cell phone **202** searches for the strongest control signal coming from the antenna tower **210**. The receiver in the cell phone **202** locks on to the strongest control channel and begins receiving control information. The control information includes the transmission frequency at which the cell phone **202** should transmit. In the exemplary environment **200**, when the cell phone **202** begins operation, it receives the strongest control signal from a transmitter associated with the cell face **214**. Thus, as depicted in Figure 1, the signal **204** from the cell phone **202** is being received by the cell face **214**. The cell phone **202** may transmit using any of a number of communications protocols known in the art. The signal **204** will follow the protocol used by the cell phone **202**. For example, the cell phone **202** may utilize an analog protocol known as Advanced Mobile Phone System (AMPS). Alternatively, the cell phone **202** may use a digital protocol, such as Time Division Multiple Access (TDMA).

The communications equipment **216** receives the signal **204** and may demodulate the signal. The communications equipment **216** typically is operable to receive signals in a variety of formats, including AMPS and TDMA. The signal **204** is sent to a cellular processor **222** via a communications link **224**. The cellular processor **222** is typically a sophisticated computing device operable to manage cellular communications at the antenna tower **210**. For example, the cellular processor **222** can monitor the signal strength of the signal **204**. Also, the cellular processor **222** can detect when the cell phone **202** has been disconnected to terminate the call **204**. The cellular processor **222** may also facilitate billing and locating the cell phone **202**. One example of a cellular

processor known in the art is the Executive Cellular Processor (ECP) manufactured by Lucent. Many other cellular processors are known in the art. The cellular processor **222** utilizes a database **226** to perform its functions. One particular function that the cellular processor **222** performs is determining which of the cell faces on the antenna tower **210** should optimally be used to receive the signal **204**.

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~~When the cell phone initially places a call **204**, the cell phone **204** may be located in the coverage area of the cell face **214**. Thus, the cell face **214** may have been optimal at the beginning of the conversation. However, the user of the cell phone **202** may be moving while the conversation is taking place. While the cell phone **202** moves in a direction **228**, the signal strength of the signal **204** will vary with respect to the cell faces **212** and **214**. The cellular processor **222** detects the variation in signal strength of the signal **204**. As the cell phone **202** moves in the direction **228**, it moves away from the cell face **214** and closer to the cell face **212**. The cellular processor **222** detects a decrease in the signal power received by the cell face **214**. Eventually, as the cell phone **202** continues to move, signal power received by the cell face **214** will be less than a minimum required level. In response, the cellular processor **222** accesses the database (in particular a neighbor list) **226** to determine which cell face the signal **204** can be transferred to.~~

The cellular processor **222** accesses the neighbor list in the database **226**. The neighbor list is generally a list of cell faces to which a signal may be transferred or handed off. For example, the database **226** has a neighbor list associated with the cell face **214**. The neighbor list for cell face **214** provides a list of available cell faces where the signal **204** can be transferred. In the example shown in Figure 1, the cell face **212** is among the available cell faces given in the cell face transfer data for the cell face **214**. After the cellular processor **222** identifies the cell face **212** as the optimal cell face, the cellular processor **222** sends a message to the communications equipment **216** indicating that the cell phone **202** should begin transmitting at a frequency associated with the cell face **212**. In response to a message from the cellular processor **222**, the transmitter for the

cell face **214** transmits a control signal to the cell phone **202** that instructs the cell phone to switch to a frequency associated with the cell face **212**. The process of transferring the cell phone signal **204** from the cell face **214** to the cell face **212** is extremely fast. There is no break in the conversation recognizable by the user of the cell phone **202**. The process of transferring a signal from one cell face to another is referred to as handing off the call.

Oftentimes, updates to the database **226** are necessary. In order to update database **226**, an embodiment of the present invention is running on a server **228** that is in communication with the cellular processor via a communication link **230**. The server preferably includes an update system that is accessible by a workstation **232** connected to the server via a communication link **234**. A user of the workstation **232** can access the update system running on the server **228** to facilitate updating of database forms. The forms may include the neighbor list. However, the forms may also include other types of cell site information data such as cell data, channel data, trunk group and member data, device data, etc.

Figure 2 illustrates an exemplary multiple cell operating environment **300** implementing an embodiment of the present invention. The environment can include one or more cells, such as cell **301**, cell **302**, cell **304**. Cells are often referred to as sites. Typically, each cell has an associated cell identification number used to identify the cell. Each cell has a base station, such as base station **306**. The cell **302** has a base station **314** and cell **304** has a base station **316**. Like the base station **220** of Figure 1, the base stations **306**, **314**, and **316** each include radio equipment and an antenna tower having one or more cell faces. Cells **301**, **302** and **304** may, but do not necessarily, overlap, as shown by an overlapping region **307**. In one embodiment, the cell **301** has a coverage area defined by a substantially hexagonal boundary **308**. During operation, a cellular processor **310** communicates with the base station **306** to monitor calls within the cell **301**. Another cellular processor **312** communicates with the base station **314** and the base station **316** to monitor calls within cell **302** and cell **304** respectively. A typical cellular

processor may be associated with 100 or more cells and base stations. The environment illustrated in Figure 2 is exemplary only and the systems and methods described can generally be applied to environments including hundreds of cells.

As has been discussed, cellular processors, such as cellular processor **310** and cellular processor **312** typically monitor various data about cellular phone calls, such as signal strength, cell phone location, and billing. The cellular processors **310** and **312** also transmit signals to a mobile switching center (MSC) **318**. The MSC **318** relays cell phone signals to an external network **320**, such as a telephone wireline network. The MSC **318** is a sophisticated system that is in communication with networks and switches around the world to determine an optimal route for cell phone calls to reach their destination.

In the exemplary environment **300**, a mobile communication device, such as a cell phone **322**, is shown in the cell **301** transmitting a signal **324** to the base station **306**. The signal **324** transmits voice data over a voice channel to a cell face at the base station **306**. The base station **306** receives the signal **324** and transmits it to the cellular processor **310** so that the cellular processor **310** can monitor the signal **324**. The cellular processor **310** may also transmit the signal **324** to the MSC **318**, which may route the signal to the external network **320**. The cell phone **322** may utilize any communications technology known in the art and the signal **324** may follow any protocol known in the art. Communications technologies include, but are not limited to, Code Division Multiple Access (CDMA), Advanced Mobile Phone System (AMPS), Global System for Mobile Communications (GSM), and Time Division Multiple Access (TDMA). Preferably, the base station **306** is operable to receive any or all of the possible communications technologies. The base station is configured to each technology – the radios are either analog or digital. An analog radio cannot handle digital calls. If the radio is a TDMA radio, it will not be able to handle GSM or CDMA calls.

As shown in Figure 2, the cell phone **322** is traveling in a direction **326**. The cell phone **322** is moving in the cell **301** toward the cell **304**. As the cell phone **322** travels, it

maintains communications with the base station **306** and the cellular processor **310** monitors the strength of the signal **324**. As the cell phone **322** moves farther from the base station **306,** the cellular processor **310** may detect that the strength of the signal **324** diminishes or weakens. The cell phone **307** travels through the overlapping region **307** where cell **304** and cell **301** overlap. When the signal strength of the signal **324** drops below a minimum power level, the cellular processor **310** accesses a neighbor list in a database **328** to determine an available cell face for a hand off. The database **328** contains a plurality of neighbor lists. Each neighbor list is associated with a cell face at a cell. Preferably each neighbor list has a cell identifier and a cell face identifier for the associated cell face. The cellular processor **310** reads cell face transfer data entries from the neighbor list that identify an available transfer cell face for a hand off. Handing off a call generally means transferring the call from one cell face to another cell face.

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~~Cell face transfer data may be updated when a new cell such as cell **304** is implemented. For example, cell **304** and its associated base station **316** may be put into service after the cells **301** and **302** are operating. When the base station **316** is put into service, a plurality of new cell faces associated with base station **316** are made available to offer mobile communication service that was not existent prior to implementation of cell **304**. As a result of the implementation of cell **304**, data in the databases **328** and **330** may be updated to reflect the addition of cell **304**. As an example, a call in cell **301** traveling into cell **304** may be handed off to a cell face of the base station **316**. The cellular processor **312** will monitor the mobile telephone user's call for various parameters including signal strength. As the traveler travels from the cell **301** toward the cell **304**, the signal strength from the call may diminish. The cellular processor **312** will send a signal to the base station **306** to initiate a hand-off to transfer the call to a cell face of the base station **316**. The cellular processor **310** accesses the cell face transfer data stored in the database **328**. The cellular processor **310** uses cell face transfer data in the database **328** to identify cell faces that are available for the call **324** to be handed-off.~~

Also shown in Figure 2 is a computer **332** communicating with the cellular

processor **310** and the cellular processor **312**. The computer **332** implements an update system in accordance with an embodiment of the present invention. The update system can automatically update the database **328** and the database **330**. The communications channel **334** can be any communications means known in the art. Examples of communications channels include, but are not limited to, Ethernet, telephone lines, or any proprietary communications protocol. A user of the computer **332** can select between the database **328** and the database **330**, and access the database to update forms on the database.

Figure 3 illustrates an exemplary cellular processor including a forms database including cell face transfer data and other types of data. A cellular processor **400** is depicted having memory **408** wherein database data is stored when accessed from a database (such as database **226**, **328** or **330**). Memory **408** can be any form of storage media known in the art, including, but not limited to random access memory (RAM), read only memory (ROM), electronically erasable programmable read only memory (EEPROM), or flash memory. Also, the form data base **402** can be stored on mass storage devices such as, but not limited to, hard drives, CD ROM, digital versatile discs (DVD), magnetic cassettes, PCMCIA card memory, or any other medium which can be used to store the desired information and which can be accessed by the cellular processor **400**. In general, the form database **402** is a table of binary encoded data that is indexable by cell identification numbers **404**. Each cell identification number **404** can identify a physical cell site. Each cell identification number **404** may also identify a cell face of a cell. For each cell identification number **404**, a plurality of forms **406** exist in the form database **402**. Each form holds a particular kind of data associated with a given cell identification number **404**, and preferably can be viewed on a computer monitor. The forms may include information regarding a cell such as latitude/longitude of the cell, the ECP/MSC the cell is associated with, the status of the cell (equipped/unequipped), how many radios of each type the cell has, trunk groups associated with the cell, etc. Other forms are also stored in the database.

Referring now to Figure 4, an interactive, menu-driven interface **500** in accordance with an embodiment of the present invention is illustrated. The interface **500** is an interface to a database. For example, the database may be a cellular site information database such as **226**, **328**, or **330**. It should also be understood that, in a preferred embodiment, the database is a cellular site information database manufactured by Ericsson. In a preferred embodiment, an update application program that is running on server **228** and/or computer **332** displays the interface **500** on a monitor. In a preferred embodiment, the interface **500** is generated using Microsoft Visual Basic and is used to display a plurality of forms. A SQL query is issued by the update application program or a SQL server to populate the fields of the form displayed on the interface **500** with data from the database. The interface accepts input from the user to create, delete, and update data in the database. In response to the user input, the update application program generates SQL queries to perform the function desired by the user.

The interface **500** illustrated in Figure 4 is a form selection screen which allows the user to select a form to view by entering a form name in form selection field **505**. The user may enter a form name such as channel, cell, trkgrp, trkmem, etc. or may enter a question mark to display a list of form names. As illustrated in Figure 4, the user has entered a question mark into the form selection field **505** and a list **510** of form names is displayed in the interface **500**. The forms listed in Figure 4 are exemplary only and are not meant to limit the invention to only those particular forms.

Referring now to Figure 5, the interactive, menu-driven interface **500** in accordance with an embodiment of the present invention is illustrated. The interface **500** illustrated in Figure 5 is the form selection screen through which the user may select a form name to display a form. As illustrated in Figure 5, the user has entered the form name "channel" in the form selection field **505**. The interface **500** also includes a database operation field **515** in which the user may enter the operation desired to be performed on the form such as review, delete, insert, update, etc. After the user has entered the form name and the operation desired into the interface, the entered form is

displayed to the user as will be described below.

Referring now to Figure 6, the interactive, menu-driven interface **500** in accordance with an embodiment of the present invention is illustrated. The interface **500** illustrated in Figure 6 displays a channel form through which the user may view and edit the channel data associated with a cell site such as cell site "G003A". Of course, the channel form is exemplary only as there are many different forms in the database that may be viewed and edited using different embodiments of the present invention. The channel form includes a cell site number (or key) field **520**, a channel data field **522**, a device column **524**, a channel number column **526**, a power column **528**, a FIT column **530** (with values such as EF (Exact Fit), NA (Nearest Above), NB (Nearest Below)), an attenuation (ATT) column **532**, a Color Code (COL) column **534**, a Secondary Color Code (SCOL) column **536** and a Voice Channel Group (VCG) column **538**.

The user selects one of these fields or columns by moving an insertion point, using the tab key on a keyboard, selecting a number corresponding to the field or column, or using another well-known selection technique. After the user selects one of the columns, the user selects one of the rows **540** and the user may make changes to the form. The user may then select the action command such as insert, review, update or delete. An insert command inserts a new record into the database; a delete command deletes an existing record from the database; a review command reads the database and populates fields in a form so that a user can review how the fields are populated; an update command modifies one or more fields.

Referring now to Figure 7, a flow diagram illustrating a computer-implemented method for updating a database form in accordance with an embodiment of the present invention will be described. At start step **705**, the method **700** begins and proceeds to step **710** when the user uses the interface to select a form for editing, such as by entering a form name. Typically, the user also selects an operation command such as insert, delete, review, update, etc. The method then proceeds to step **715** where the form is displayed to the user. To display the form, typically one or more SQL queries are

generated and sent to the database so that the appropriate information may be retrieved and displayed.

At step **720**, the user modifies the displayed form. Typically, the user will enter a key field **520** to select a specific form, the user will then select the field for editing (including the particular row and column), make changes and then selects again the command desired such as insert, review, update or delete.

For example, the user may first select the form and then the operation, such as insert/update/delete/review. In the case of update, the user will make the changes to one or more fields; then when he is finished with making changes, he will again type in "u" to proceed with the update. In the case of insert, the user will select the form and then the operation, namely, insert; he will enter values for all the fields in the form and will enter in "i" to insert the form. In the case of review, the user will select the form, and then the operation (review). Then he will give the key fields. The system will generate queries to get the data from the database and then will populate the form with values for the user to review.

At step **725**, the form or display is updated according to the command selected by the user. One or more SQL queries may be generated and sent to the database to edit the database according to the user's changes.

The method then ends at step **799**.

Although embodiments of the present invention have been described above using SQL commands to interact with the cell site information database, it should be understood that other languages well-known to those skilled in the art may also be used. Moreover, line commands may be automatically generated to interact with the cell site information database based on user input. For example, if the user edits a vcg field for a particular cell-site, the update application program module may automatically generate a line command, input the line command into a command handler application program (such as the Ericsson command handler application program running on the Ericsson OSS). The command handler application program module may then interact with the cell

site information database based on the line commands.

It should be understood from the foregoing description that the present invention is user-friendly and easy to use. The present invention is faster than the current method of updating databases. Updates to databases can be done from the desktop with no need to log onto the Ericsson Operation Support System (OSS) and no need to enter line commands into the OSS. There is no need for special training to learn line commands to update databases.

It should be understood that in some embodiments of the invention, messages will be displayed to the user if there are any problems in the input data. For example, if the user is in Review mode and wants to review data for a cell number and he enters the cell number, but no record exist for the cell number that he entered – an error message will be displayed to the user. Another example is if a user is trying to update one or more fields and the update is successful, a message "Form Updated" will be shown on the screen. If the update is unsuccessful (a wrong value is entered for a field), an error message will be shown and the form won't be updated. In a preferred embodiment, the bottom 3 lines in the screen will be reserved for showing error messages and the top line will be reserved for showing updates – Form Updated/Form not updated/Retrieving form/Updating/Deleting, etc.

Although the present invention has been described above as implemented in a preferred embodiment, it will be understood that alternative embodiments will become apparent to those skilled in the art to which the present invention pertains without departing from its spirit and scope. Accordingly, the scope of the present invention is defined by the appended claims rather than the foregoing description.